# High-Efficiency, High-Temperature, Ultra-Lightweight GaP-Based Solar Cells, Phase I

Completed Technology Project (2007 - 2007)

## Project Introduction

The objective of this proposal is to study and demonstrate novel GaAsNP/GaP/AlGaP technology for use in extreme photovoltaic (PV) energy conversion. NASA and the scientific community are interested in solar missions that go as far as Saturn or even into near sun conditions. Such missions present a challenging problem for PV technology. In addition to the requisite high efficiency and reduced solar cell payload mass, these missions require a PV technology that can withstand the increased solar intensity, radiation and temperature. We propose studying two possible solar cell designs: The first design utilizes novel, wide gap GaP-based materials to provide bandgaps well suited for high-temperature operation and to enhance function in high radiation and near sun missions. Such an approach will enable solar cells to operate at and above 450 Celcius with the highest possible efficiency. As part of this study we would investigate the deposition of AlGaP on GaP to provide materials with bandgaps at or above 2.4 eV. The second design we will investigate uses more standard materials that EpiWorks has already developed for different applications. This design would employ InAlP (2.4eV bandgap) lattice-matched to GaAs as the key wide gap material. We will study the expected temperature dependence and other key thermal properties of such a design and compare to the GaP-based approach.

## Anticipated Benefits

EpiWorks plans to pursue NASA, military and potential commercial customers with a new GaP-based solar cell technology. In addition to NASA Saturn, near-sun and related missions, we will initially focus on the DoD and commercial space-based solar cell market. This market demands solar cell technology with high efficiency and low weights. If a lightweight, and thermally robust, efficient solar cell technology were available, it could provide significant opportunity with other space-based applications. These capabilities are especially important for next-generation DoD and commercial satellites. In phase II we will be developing an initial prototype device. In parallel, EpiWorks plans to team with at least one commercial partner as well as 1-2 government partners (preferably AFRL and NREL) to complete product development and begin production. efficiency solar cell arrays for NASA missions and DoD satellites. For NASA, future missions will continue to probe closer and closer to the sun. A potential, but unlikely application would be solar probes, but the most likely application would missions such as a Mercury surface station with an equilibrium temperature of ~450 Celsius. In these future missions, it is critical to develop solar cell PV technology that can operate from 450-1000 Celsius in high radiation and high intensity environments. Our near term commercialization strategy will be to develop a solar cell PV technology that can operate at high-efficiency in these conditions. It is also important to note that our technology could be utilized with "Solar Clipper" concentrator systems.


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## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Glenn Research Center (GRC)

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

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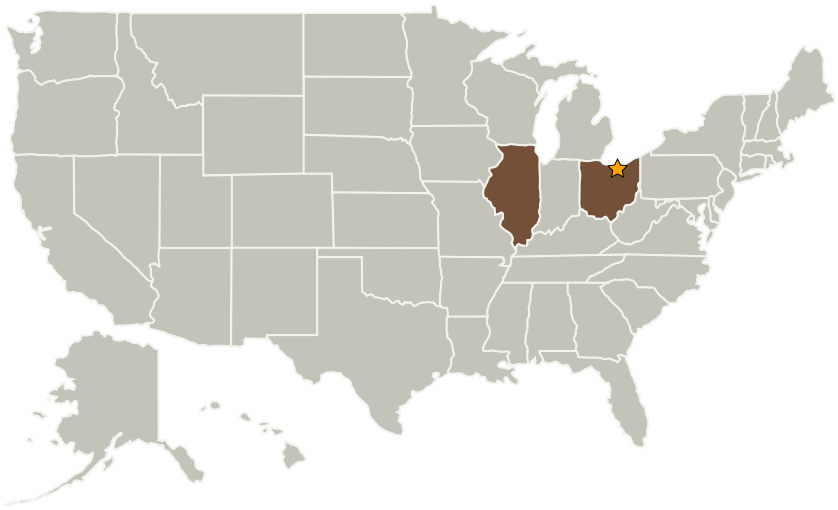
## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| ★Glenn Research Center(GRC) | Lead Organization | NASA Center | Cleveland, Ohio |
| EpiWorks, Inc. | Supporting Organization | Industry | Champaign, Illinois |

| Primary U.S. Work Locations | |
|---|---|
| Illinois | Ohio |

## Project Management

**Program Director:**
Jason L Kessler

**Program Manager:**
Carlos Torrez

**Project Manager:**
Eric B Clark

**Principal Investigator:**
David Ahmari

## Technology Areas

**Primary:**

- TX03 Aerospace Power and Energy Storage
  - TX03.1 Power Generation and Energy Conversion
    - TX03.1.1 Photovoltaic